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THE EM-182 EXCAVATOR IN ACTION

In 1948 a number of brick plants of the Ministry of Construction of Heavy Industry Enterprises received EM-182 multibucket excavators to mechanize the digging of clay.

"Tagilstroy" Trust also received one of these excavators at the beginning of the 1948 season for the quarry of a brick plant. The excavator was used to dig clay of average consistency over an arc-shaped strip of ground. The height of the bench was 6 - 7 meters. The length of the strip was about 100 meters. Because of the nature of the clay, standard gauge track at first had to be laid on a grade of 0,020. The grade of the tracks complicated the movement of the excavator. Later the ground slope was corrected, and the grade was decreased to 0.009 - 0.007. The excavated clay was hauled in cars drawn by gasoline locomotives.

Since only one limited strip could be worked at a time, the tracks had to be moved periodically. The excavators lost about 6-7 hours every time the tracks were moved. To reduce the number of necessary moves, a method of radial excavation, which guaranteed continual filling of the buckets was employed. The length of each movement along the tracks was then increased to 1.2 - 1.3 meters instead of 0.4 meters as was the case in parallel excavating. The critical angle of dip of the bench after it has been worked out is 54 degrees. The maximum area of a transverse section of the stope is 9.5 square meters. For 100 meters of workings the excavator had to be moved over the tracks every 95 - 100 hours of work, or every 12 - 13 shifts.

The distance between excavator tracks and car tracks was set at 1,790 millimeters, but each track was laid on its own ties. This process cannot be considered normal inasmuch as the movement of tracks is thus complicated and delayed. It would be more rational to set both tracks on common ties 3.5 - 3.6 meters long.

During a period of observation of the excavators, the average speed of movement of cars was 0,04 meters per second and of bucket conveyers, 0.32 meters per second. To load one car with 0.7 cubic meters of clay,

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40 - 48 buckets are required in dry weather and 56 - 64 in damp weather [sic]. The actual load per bucket in dry weather is 14.6 - 17.5 liters and in damp weather, 11 - 12.5. The volumetric coefficient is 0.88 and 0.64 respectively. These indices are considered quite satisfactory.

The maximum theoretical productivity of these excavators is 20 cubic meters per hour.

According to observed data, a car was loaded with clay in 2.5 - 3 minutes in dry weather and in 3 - 4 minutes in wet weather. The time for coupling an empty car and uncoupling a loaded car was 0.5 minutes. The time for emptying a bucket in dry weather was 0.3 - 0.6 minutes (for each car).

These results indicate the possibility of excavator productivity reaching 14 cubic meters per hour, or 112 cubic meters per shift in dry weather and 11 cubic meters per hour, or 88 cubic meters per shift in damp weather.

The work of an excavator which was operated from 21 June to 1 September 1948 is given in the following table:

Table 1

	Jun	Jul	Aug
No of shifts worked	14	50	52
Total working hours	112	400	416
Hours of actual work	56	228	241
Coefficient of time utilization	0.50	0.57	0.58
Monthly output of excavator (cu m)	482	2,160	2,629
Avg shift output of excavator (cu m)	34.5	43.2	50.5
Avg hourly output for total working time (cu m)	4.3	5.4	6.3
Avg hourly output for actual working time (cu m)	8.6	9.5	10.9

The productive period of operation of an excavator during individual shifts in August was up to 5.44 hours per shift (68 percent of the total time of the shift). The distribution of working time per shift is given in the following table:

Table 2

Operation	Avg Duration of Operation (in min)	Percent of Total Shift Time
Reception of shift	15	3
Loading of cars	325	68
Awaiting removal of loaded cars	35	7

(Continued)

Operation	Avg Duration of Operation (in min)	Percent of Total Shift Time
Awaiting arrival of empty cars	80	17
Time lost in repair of excavator	5	1
Time lost in auxiliary operations	20	4
Total	480	100

After the excavator had been in operation for 1,100 hours, the following parts showed the greatest wear.

1. Bucket Conveyer

a. The interior and exterior links of the conveyer chain located at the joints which join the buckets to the chain: as a result of friction on the lower guide bar of the lower bucket frame, 12 links had to be replaced during 960 hours of work.

b. The bushing of the interior links and cam of the chain: the wear was unequal due to unequal heat treatment of the links and cams; during 400 hours of work 10 percent of the bushings and 10 percent of the cams had to be replaced.

c. The cover plates which protect the bucket conveyer from abrasion during motion; the wear was unequal; during 400 hours of work 70 percent of the cover plates had to be replaced.

d. During 400 hours of work by the excavator all the bucket teeth were completely worn out and had to be replaced; wear was equal.

e. The lip of the bucket suffered 10 percent wear along its entire width during 1,100 hours of work.

2. Lower Bucket Frame

a. The guide plates of the lower bucket frame: during 1,100 hours of work these plates were equally worn up to $\frac{1}{2}$ of their thickness.

b. The guides of the plane links: after 930 hours these had to be replaced.

3. Sprocket Wheel Axle

Wear on the teeth of the sprocket wheel axle was up to 5 millimeters after 1,100 hours of work.

Wear of the remaining parts (roller bearings which support the idling arm of the bucket conveyer, teeth of the conveyer pinion, running gear, the mechanism for raising the jib and turning the bucket conveyer, clutch, shaft and axle journal) was insignificant after 1,100 hours of work.

Except for the flange of the driving wheel which was broken and had to be replaced, the excavator did not lose any time from work. During the course of work, the bucket conveyer, and the drive, main, sprocket wheel, feed and worm shafts required fortified lubricants. Grease and machine oil were used as lubricants. About 1.2 kilograms of oil were consumed at every shift.

Consumption of electric power varies from 85 to 110 kilowatt hours per shift, an average of 1.98 kilowatt hours for every cubic meter of clay.

The number of workers employed in excavator operations is given in the following table. The number of workers formerly engaged in hand processing of clay with cable haulage is given by way of comparison.

Table 3

Hand Processing		Excavator Processing	
Name of Job	No of Men per Shift	Name of Job	No of Men per Shift
Cutter	7	Excavator driver	1
Chain hoisters (drawers)	2	Chute drawers (chain hoisters)	2
Track workers	1	Track workers	2
Driver	1	Gasoline locomotive driver	1
Shift electrician	1	Shift electrician	1
Total	12		7

Conclusions

1.. Effective use of excavators is only possible over straight, flat strips where the deviation of the rails does not exceed 0.007 - 0.010.

2. The capacity of the engine of the excavator is insufficient, as practice has indicated, when thick clay is being processed. Installation of a motor of 18 kilowatts, 970 revolutions per minute, is desirable. However, because of difficulties involved, a change of engines is not carried out in actual practice.

3. The excavator has a number of defects in its assembly and alignment. For example, the position of the dual arresting supports, by which the buckets abut on the chain, is bad, and causes bending of the links of the chain and increases abrasion. Considerable wear of certain parts is caused by uneven heat treatment of friction areas.

4. The bunker of the excavator is not large enough to hold rocks for loading on the cars, and therefore its size should be increased; the slant of the bottom of the bunker must permit rock to fall into the center of the car.

5. The correction of these defects can be easily carried out in the process of manufacturing the next model of this type excavator. The excavator will then satisfy the requirements for processing clay quarries, and can be recommended for processing of seasonal quarries, especially where the clay is heterogenous and requires mixing.

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